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Local metal-insulator transitions in VO₂ thin films studied by ⁵⁷Fe emission Mössbauer spectroscopy

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VO₂ shares the similar metal-insulator transitions (MIT) and structural phase transition properties as the V₂O₃ and found equally important applications in Mott memory and neuromorphic devices, which surpass the limitations of conventional electronics. In contrast, MIT occurs at much higher temperature (340 K) in VO₂ than that (160 K) in V₂O₃. Furthermore, the MIT of VO₂ is much more robust and less susceptible to implantation-induced disorder than for V₂O₃. This indicates that the formation of the MIT and the structural-phase transition in VO₂ are dominated by local properties, which is more suitable to be probed by the emission Mössbauer spectroscopy. Based on the results obtained from V₂O₃ in 2016 and 2017 beam times, we noticed that the V₂O₃ was prone to implantation damage, this limits the power of the emission Mössbauer spectroscopy to closely follow the MIT process. Although some measurements were done on the VO₂ thin film samples in 2015, the results are not conclusive mostly due to the film quality. Here we propose to refocus on the application of emission Mössbauer spectroscopy to study the local-scale MIT phenomena in VO₂ thin films with improved structural and stoichiometric quality.

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